PROJECT DESCRIPTION

Grantee: King George County Service Authority (Dahlgren)
Grant: #440-S-14-04

The King George County Service Authority (KGCSA) owns and operates the Dahlgren Waste Water Treatment Plant (WWTP) in Dahlgren, Virginia. The Dahlgren WWTP treatment process includes an Orbal oxidation ditch and standard tertiary disc filters. In 2006, an upgrade was completed to increase the plant capacity to 1.0 million gallons per day (MGD). At the time of the upgrade, the plant was operated in extended aeration activated sludge (EAAS) mode, although provisions were made to allow operation in biological nutrient removal (BNR) mode should the need arise. The 2006 upgrade did not include supplemental carbon feed, online nutrient analyzer instrumentation, or denitrifying filters that would be required for compliance with the discharge limits that are near state of the art (SOA) nutrient removal.

After the completion of the original NRT upgrade, the KGCSA obtained WQIF grant funding retroactively for certain components of the plant. This (prior) grant agreement, requires annual average effluent performance standard levels of 4.0 mg/L for total nitrogen (TN) and 0.30 mg/L of total phosphorus (TP).

The Authority was unable to consistently meet these performance standards. The KGCSA implemented several optimization measures including changing the oxidation ditch configuration from EAAS to BNR mode, changing the internal recycle by adding air lift pumps and recycle to a different location, converting the soda ash chemical feed to add molasses as a supplemental carbon source, and recent purchase of hand held ammonia and nitrate instrumentation. These corrective actions improved the nutrient removal efficiency at the facility; however the existing plant cannot consistently meet the existing VPDES TN and TP permit limits and the existing WQIF TN and TP performance standards. Therefore additional engineering investigation revealed the following deficiencies:

1. The ratio of TKN to CBOD5 is too high for removal by bio-accumulation. In order to achieve the current performance TN standard of 4.0 mg/L and the **Phase II grant agreement annual average performance standard of 3.0 mg/L,** the plant must have accurate control of both the DO and supplemental carbon feed.

2. The operators do not have the ability to observe the process in real time and make adjustments necessary to fine tune the process.

3. There is no automation for process changes that occur during the 8 hours a day that the plant is unmanned.

4. The sludge wasting is not automated, which leads to the potential for human error.

5. Autotrophic microorganism (nitrifiers and denitrifiers) are far more sensitive to changes in temperature and organic loading than heterotrophic microorganisms. In order to adjust to temperature changes, appropriate adjustments need to be made to the mixed liquor suspended solids concentrations, which is currently subject to human error.

6. There is a lack of a control system that uses input parameters other than DO. DO systems are good for CBOD removal, but are not accurate enough for high rate of removal of nutrients.

7. The process cannot reliably denitrify to comply with existing VPDES TN and TP permit limits, especially as flows continue to increase.

Based on the analysis of the plant, the following measures are part of the Phase II WWTP upgrade:

1. Installation of 1500 gallon Bulk Supplemental Carbon (liquid molasses) Tank and variable speed solution pump. This system will be set up in the existing old filter press building and will discharge into the outer ring near the mixers. This building is heated and ventilated.

2. Installation of a continuous effluent nitrate sensor and monitoring system. This system will be the indicator for the monitoring of the biological denitrification process. The monitor will provide 4-20 mA signals that will primarily control the supplemental carbon feed rate and provide secondary data for dissolved oxygen controls. The sensor will provide real time concentrations and trending patterns for adjusting to achieve optimum treatment efficiencies while accounting for any fluctuations in flows, raw characteristics, and temperatures. These continuous automatic adjustments will be made 24 hours a day.

3. Installation of a continuous effluent Ammonia sensor and monitoring system. This system will provide information for the primary control of the dissolved oxygen within the existing ditches and a primary indicator of the nitrification process. This will maximize the biological nitrification process. The sensor will provide real time data that will utilize 4-20 mA signals to adjust the variable speed drives of the existing disc rotors. Again, these sensors will account for any fluctuations in flows, raw characteristics, microbial activity and temperatures. These continuous automatic adjustments will be made 24 hours a day.

4. Installation of a continuous MLSS sensor and monitor. This sensor would provide continuous monitoring and trending of the MLSS. This data would trigger wasting operations and/ increased retention for maintaining the optimum concentration of biomass for efficient biological nitrification and denitrification.

5. Installation of continuous effluent Phosphorus sensor and monitor. This would allow for operator adjustments of the alum feed rate to account for any changes in the flow or raw water strength based on real time data.

6. Installation of ten IFAS modules in the oxidation ditch with air burst connection for cleaning.

7. Provide replacement 2 mm step screen at the headworks to provide improved solids removal at the plant.

8. Provide two turbo blowers in the old filter press building to power air lift pumps for internal recycle. The pumps are VFD controlled which will allow the internal recycle pump flow rate to be adjusted based on incoming flow.

9. Update SCADA software and integrate new equipment. Provide a new raw water influent magmeter for improved equalization.